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EDITORIAL

Special issue on *Multidimensional systems theory and control*

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Multidimensional systems and signal processing is, today more than ever before, a very lively research area, which attracts a great deal of attention and research interest, both in the control and signal processing communities. Indeed, an increasingly wider research community devotes much of its efforts to the solution of control, estimation and signal processing problems involving multidimensional systems. This is undoubtedly motivated by the fact that this area plays a crucial role in a variety of applications, ranging from remote sensing for environmental monitoring and geological mapping, to medical imaging and the automatic control of industrial processes. The impact that this topic has shown in recent years in events such as the International Symposium on Mathematical Theory of Networks and Systems (MTNS), and the importance of other events entirely devoted to this topic, such as the International Workshop on Multidimensional Systems (nDS), are a clear evidence of the increasing interest that this area attracts within the control, signal processing and mathematics communities. The broad range of application areas for multidimensional systems and signal processing, the great need to tackle unsolved fundamental mathematical problems within this area, and the ever increasing capacity of computing technologies, provide substantial motivation for further development of the underlying mathematical tools.

Motivated by these facts, this Special Issue aims at providing an overview of several recent developments in this wide area. The contributions selected for this Special Issue clearly display the broad scope of multidimensional systems, from open mathematical

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questions to practical engineering problems, and emphasize its interdisciplinary nature and cover some recent developments in n-D control and systems theory. Eight papers have been finally accepted in this special issue, which could be broadly put into two parts: systems theory and control for general 2-D or n-D systems in the first part, and stability analysis and control for repetitive processes in the second part. A brief description of papers in each part is given below.

The six papers in the first part cover topics such as geometric theory, observer and controller design, stability, optimal solution, filtering for general 2-D or n-D systems. The first paper, authored by the first Guest Editor and Michael Cantoni, presents a geometric theory for 2-D implicit systems, via the introduction of the new concepts of controlled invariance of "state"-feedback type and conditioned invariance of output-injection type. The second paper is a paper by Lu Wang et al., and it considers the design of asymptotic stable unknown input observers for a class of nonlinear 2-D systems. The next paper by Ewaryst Rafajłowicz and Wojciech Rafajłowicz presents a new method for synthesizing a controller for n-D systems that guarantees minimal sensitivity to parametric uncertainties. The paper by Dorota Bors and Marek Majewski presents an optimal solution and makes an important advance in the area of continuous Fornasini–Marchesini models. The problem of determining LMI conditions for the analysis of the robust stability of hybrid Roesser models against parametric uncertainties is tackled in the paper by Mariem Ghamgui et al. The last paper in this part is by C. El-Kasri et al. It addresses the problem of robust H_∞ filtering for 2-D continuous Roesser models with time-varying delays, and also with uncertainties of polytopic type.

The two papers in the second part focus on repetitive processes, which constitute a subclass of 2-D systems where the propagation of the information occurring in one direction is of finite duration. These processes are gaining increasing attention due to their relevance in industrial applications. In this part, the first paper comes from Błażej Cichy et al. and is also co-authored by the second Guest Editor. This paper deals with the design of the control for linear repetitive processes in the cases where the update structure of these processes cannot be represented by the standard Fornasini–Marchesini or Roesser models. The last but not the least important paper is by Wojciech Paszke and Olivier Bachelier. It studies the stability analysis and control synthesis in finite frequency domain for linear repetitive processes with polytopic uncertainties. Importantly, this method enables the designer to specify the frequency range for the control performance.

We are particularly grateful to the reviewers of this Special Issue for their valuable reviews in a timely manner maintaining the high standards of MSSP. Finally, we would like to thank the authors who submitted their research manuscripts, promoting further research and inspiring new approaches to address the important technical challenges in the field. We would also like to thank Prof. Zhiping Lin, Editor-in-Chief of MSSP, for the enthusiastic support of this Special Issue.